

Claims

- [c1] 1. A cured composition comprising a cured residue of a curable composition comprising:
- (a) an epoxy resin and curing agent therefor, wherein said epoxy resin is essentially free of bromine atoms;
 - (b) a flame retardant additive essentially free of phenolic groups and of epoxy groups, wherein said flame retardant is a condensation product of (i) a brominated phenol or a mixture of brominated phenols with (ii) a cyanuric halide; and
 - (c) a thermoplastic resin.
- [c2] 2. The cured composition of claim 1, wherein said flame retardant additive has a bromine content greater than 20%.
- [c3] 3. The cured composition of claim 1, wherein said flame retardant additive is 1,3,5-tris(2,4,6-tribromophenoxy)triazine.
- [c4] 4. The cured composition of claim 1, wherein said flame retardant additive is 2,2'-[[1-methylethylidene)bis[(2,6-dibromo-4,1-phenylene)oxy]]bis[4,6-bis[(2,4,6-tribromophenyl)oxy]-1,3,5-triazine].
- [c5] 5. The cured composition of claim 1, wherein said flame retardant additive is soluble in toluene at a concentration of greater than 15 g/100ml of toluene at a temperature of 50 ° C.
- [c6] 6. The cured composition of claim 1, wherein said epoxy resin is a glycidyl ether resin or a mixture of glycidyl ether resins containing, on average, greater than 2 epoxy groups per molecule.
- [c7] 7. The cured composition of claim 1, wherein said epoxy resin is a mixture of:
- (a1) an epoxy resin containing on average less than or equal to 2 glycidyl groups per molecule; and
 - (a2) an epoxy resin containing greater than 2 glycidyl groups per molecule.
- [c8] 8. The cured composition of claim 1, wherein said thermoplastic resin has a Tg greater than 120 ° C.

[c9] 9. The cured composition of claim 1, wherein said thermoplastic resin has a dissipation factor of less than 0.010 measured at 1 MHz at room temperature.

[c10] 10. The cured composition of claim 1, wherein said thermoplastic resin has been directly isolated from solution after polymerization.

[c11] 11. The cured composition of claim 1, wherein said thermoplastic resin is a poly(phenylene ether).

[c12] 12. The cured composition of claim 11, wherein said poly(phenylene ether) has a weight average molecular weight ranging from about 3,000 to 35,000 g/mol.

[c13] 13. The cured composition of claim 11, wherein said poly(phenylene ether) has a weight average molecular weight ranging from about 3,000 to 35,000 g/mol.

[c14] 14. The cured composition of claim 11, wherein said poly(phenylene ether) has been melt processed at a temperature ranging from about 200 ° to 350 ° C.

[c15] 15. The cured composition of claim 11, wherein said poly(phenylene ether) is hydroxy functional.

[c16] 16. The cured composition of claim 1, wherein said thermoplastic resin is one or more of a poly(phenylene ether) or a poly(styrene-*co*-maleic anhydride).

[c17] 17. The cured composition of claim 1, wherein said thermoplastic resin is a reaction product of a poly(phenylene ether) and a peroxide.

[c18] 18. The cured composition of claim 1, wherein said thermoplastic resin is a reaction product of a poly(phenylene ether), a peroxide, and a bisphenol.

[c19] 19. The cured composition of claim 1, wherein said thermoplastic resin is a polyimide.

[c20] 20. The cured composition of claim 1, wherein the curable composition further comprises one or more of an organic reinforcement, an inorganic reinforcement, or a filler.

[c21] 21. The cured composition of claim 1, wherein the curable composition is essentially free of homopolymers of styrene.

- [c22] 22. The cured composition of claim 1, wherein the epoxy resin is a multifunctional glycidyl ether.
- [c23] 23. The cured composition of claim 22, wherein said multifunctional glycidyl ether is selected from the group consisting of epoxidized phenol-formaldehyde novolacs, epoxidized cresol-formaldehyde novolacs, epoxidized alkylphenol-formaldehyde novolacs, epoxidized 1,1,1-tris(4-hydroxyphenyl)ethane, epoxidized 1,1,2,2-tetra(4-hydroxyphenyl) ethane, epoxidized phenol-dicyclopentadiene novolacs, and epoxidized phenol-benzaldehyde novolacs.
- [c24] 24. A cured composition comprising a cured residue of a curable composition comprising:
- (a) an epoxy resin and curing agent therefor, wherein said epoxy resin is a glycidyl ether resin or mixture of glycidyl ether resins containing, on average, greater than 2 epoxy groups per molecule;
 - (b) 1,3,5-tris(2,4,6-tribromophenoxy)triazine and/or 2,2'-[(1-methylethylidene)bis[(2,6-dibromo-4,1-phenylene)oxy]]bis[4,6-bis[(2,4,6-tribromophenyl)oxy]-1,3,5-triazine]; and
 - (c) a poly(phenylene ether) resin.
- [c25] 25. A cured composition comprising a cured residue of a curable composition comprising:
- (a) an epoxidized cresol-formaldehyde novolac resin;
 - (b) 1,3,5-tris(2,4,6-tribromophenoxy)triazine; and
 - (c) a poly(phenylene ether) resin having a number average molecular weight ranging from about 1,000 to 15,000 g/mol.
- [c26] 26. A laminate, comprising:
- a metal foil having a surface; and
 - disposed on the surface of the metal foil, a cured residue of a curable composition comprising:
 - (a) an epoxy resin and curing agent therefor, wherein said epoxy resin is essentially free of bromine atoms;
 - (b) a flame retardant additive essentially free of phenolic groups and of epoxy groups, wherein said flame retardant is a condensation product of (i) a

brominated phenol or a mixture of brominated phenols with (ii) a cyanuric halide; and

(c) a thermoplastic resin.

- [c27] 27. The laminate of claim 26, wherein said flame retardant additive has a bromine content greater than 20%.
- [c28] 28. The laminate of claim 26, wherein said flame retardant additive is 1,3,5-tris(2,4,6-tribromophenoxy)triazine.
- [c29] 29. The laminate of claim 26, wherein said flame retardant additive is 2,2'-[(1-methylethylidene)bis[(2,6-dibromo-4,1-phenylene)oxy]]bis[4,6-bis[(2,4,6-tribromophenyl)oxy]-1,3,5-triazine].
- [c30] 30. The laminate of claim 26, wherein said epoxy resin is a glycidyl ether resin or a mixture of glycidyl ether resins containing, on average, greater than 2 epoxy groups per molecule.
- [c31] 31. The laminate of claim 26, wherein said thermoplastic resin has a Tg greater than 120 ° C.
- [c32] 32. The laminate of claim 26, wherein said thermoplastic resin has a dissipation factor of less than 0.010 measured at 1 MHz at room temperature.
- [c33] 33. The laminate of claim 26, wherein said thermoplastic resin is a poly(phenylene ether).
- [c34] 34. The laminate of claim 33, wherein the poly(phenylene ether) has a number average molecular weight ranging from about 1,000 to 15, 000 g/mol.
- [c35] 35. The laminate of claim 33, wherein the poly(phenylene ether) has a weight average molecular weight ranging from about 3,000 to 35, 000 g/mol.
- [c36] 36. The laminate of claim 26, wherein said thermoplastic resin is one or more of poly(phenylene ether) or poly(styrene- co -maleic anhydride).
- [c37] 37. The laminate of claim 26, wherein said thermoplastic resin is the reaction product of a poly(phenylene ether) and a peroxide.

- [c38] 38. The laminate of claim 26, wherein said thermoplastic resin is the reaction product of a poly(phenylene ether), a peroxide, and a bisphenol.
- [c39] 39. The laminate of claim 26, wherein said thermoplastic resin is a polyimide.
- [c40] 40. The laminate of claim 26 wherein the curable composition further comprises one or more of an organic reinforcement, an inorganic reinforcement, or a filler.
- [c41] 41. The laminate of claim 26, wherein the curable composition is essentially free of homopolymers of styrene.
- [c42] 42. The laminate of claim 26, wherein the epoxy resin is a multifunctional glycidyl ether.
- [c43] 43. The laminate of claim 42, wherein said multifunctional glycidyl ether is selected from the group consisting of epoxidized phenol-formaldehyde novolacs, epoxidized cresol-formaldehyde novolacs, epoxidized alkylphenol-formaldehyde novolacs, epoxidized 1,1,1-tris(4-hydroxyphenyl)ethane, epoxidized 1,1,2,2-tetra(4-hydroxyphenyl) ethane, epoxidized phenol-dicyclopentadiene novolacs, and epoxidized phenol-benzaldehyde novolacs.
- [c44] 44. A laminate, comprising:
a metal foil having a surface; and
disposed on the surface of the metal foil, a cured residue of a curable composition comprising:
(a) an epoxy resin and curing agent therefor, wherein said epoxy resin is a glycidyl ether resin or mixture of glycidyl ether resins containing, on average, greater than 2 epoxy groups per molecule;
(b) 1,3,5-tris(2,4,6-tribromophenoxy)triazine and/or 2,2'-[(1-methylethylidene)bis[(2,6-dibromo-4,1-phenylene)oxy]]bis[4,6-bis[(2,4,6-tribromophenyl)oxy]-1,3,5-triazine]; and
(c) a poly(phenylene ether) resin.
- [c45] 45. A laminate, comprising:
a metal foil having a surface; and
disposed on the surface of the metal foil, a cured residue of a curable

